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CASE REPORT

Venous Stasis Retinopathy Complicating a Case of Cavernous-carotid Fistula with an Initial Normal Computed Tomography Angiogram of the Brain

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ABSTRAK

'Carotid-cavernous fistula' (CCF) boleh berlaku secara spontan atau akibat kecederaan. Disebabkan komplikasi pada mata, proses mengenalpasti penyakit dan rawatan tidak harus ditangguhkan. Kami ingin melaporkan satu kes di mana seorang wanita tua yang mengalami kemerahan mata dan kemudiannya mata menjadi semakin bengkak. Beliau disyaki menghidapi penyakit CCF tetapi pemeriksaan imbasan tomografi berkomputer pada otak dilaporkan normal. Pesakit kemudiannya dijadualkan untuk cerebral angiografi dan beliau dikenalpasti menghidap penyakit CCF. Malangnya, pesakit tersebut mengalami komplikasi seperti retinopati stasis vena dan glaukoma neovascular disebabkan rawatan tergendala. Penglihatan beliau tidak dapat disembuhkan walaupun rawatan agresif telah diberikan. Kes ini bertujuan untuk menekankan kepentingan mengesyaki sesuatu penyakit melalui pemeriksaan klinikal walaupun dengan imbasan imej yang normal. Ini adalah untuk mengelakkan komplikasi seperti kebutaan yang tidak dapat disembuhkan.

Kata kunci: cerebral angiografi, fistula carotid-cavernous, glaukoma neovascular

ABSTRACT

Carotid-cavernous fistula (CCF) can be spontaneous or due to trauma. Due to its complication to the eye, diagnosis and intervention should not be delayed. We report a case of an elderly female who presented with left eye redness with gradual onset of protrusion over the same eye. She was suspected to have CCF with the clinical presentation. Nevertheless, she had a normal computed tomography angiogram of the brain. Later, she was scheduled for cerebral angiography and the

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diagnosis of CCF was confirmed. However, due to delay in diagnosis and treatment, the patient developed venous stasis retinopathy and neovascular glaucoma. Her vision remained poor despite aggressive systemic and ocular treatments. This case report is to emphasise the importance of clinical suspicion of a disease despite a normal imaging. This is to prevent irreversible blindness and other systemic complications.

Keywords: carotid-cavernous fistula, cerebral angiography, neovascular glaucoma

INTRODUCTION

Cavernous sinus is a venous plexus located at middle cranial fossa which receives drainage from several tributaries such as superior and inferior ophthalmic vein, sphenoparietal sinus, superficial and inferior middle cerebral vein, small cerebral vein and hypoglossal vein (Ellis et al. 2012). Carotid-cavernous fistula (CCF) is a condition in which there is an abnormal communication between carotid artery and cavernous sinus leading to abnormal vascular shunt. Patients commonly present with acute proptosis, chemosis, orbital bruit and headache (Chaudhry et al. 2009). In this report, we present a case of indirect CCF which had a normal computed tomography angiogram of the brain. Diagnosis was confirmed later by cerebral angiography.

CASE REPORT

A 70-year-old female with underlying diabetes mellitus and dyslipidaemia was previously on yearly follow-up for her diabetic retinopathy screening. She had no sign of diabetic retinopathy in the previous follow-up. She came to casualty with a chief complaint of redness in the left eye for one month prior to presentation. It was associated with progressive, painless protrusion of the left eye. There was no associated tearing or eye discharge. She did not have blurring of vision, diplopia, floaters or flashes. She did not experience headache, nausea, vomiting or any constitutional symptoms. There were no symptoms of hyperthyroidism or hypothyroidism. On examination, the left eye vision was 6/18 with pinhole 6/18 and near vision of N6 with no relative pupillary afferent defect. Her vision corresponded to her cataract status which was nuclear sclerosis grade 2+. Otherwise, her optic nerve function test was normal. Left eye conjunctiva was chemosed and injected with presence of corkscrew vessels (Figure 1). Anterior chamber of left eye was deep with occasional cells. Intraocular pressure (IOP) of left eye was raised (24 mmHg) with no further raised in IOP on upgaze. Helter's exophthalmometer showed left proptosis with measurement of 16 mm over the right eye and 21 mm over the left eye. There was no audible bruit on auscultation of the left globe. Extraocular movement was

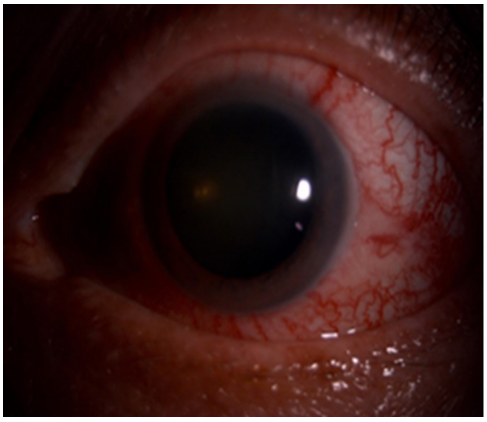

Figure 1: Anterior segment photo of left eye during first presentation showing cork-screw vessels

full with no diplopia. Clinically, she was euthyroid. Fundus examination showed normal left eye optic disc with few dot haemorrhages over the peripheral retina suggestive of mild non-proliferative diabetic retinopathy without maculopathy. Right eye fundus was normal with no diabetic retinopathy changes. The vessels appeared normal in calliper and there was no dilatation or tortuosity of the vessels. Systemic examination showed no palpable neck mass or lymph nodes. Basic uveitic work up was normal. In view of clinical signs of cavernous-carotid fistula, computed tomography angiogram (CTA) of the brain was performed but there was no evidence of CCF on CTA. It showed left eye unilateral proptosis and enlargement of left medial and inferior recti sparing the tendon (Figure 2). Both superior ophthalmic veins were not dilated as well. Thyroid function test was however normal. In view the clinical picture and blood investigation did not convince the diagnosis of thyroid eye disease, she was subsequently scheduled for cerebral angiogram after discussion with neurosurgery team. Cerebral angiogram showed evidence of left indirect cavernous-carotid fistula with the branches noted from cavernous segment of internal carotid artery (ICA) (Figure 3). She was advised by the interventional radiologist to undergo embolisation. Unfortunately, the procedure was delayed due to financial problems. Three months later, patient's vision had dropped to 6/36 with pinhole 6/36. Clinical

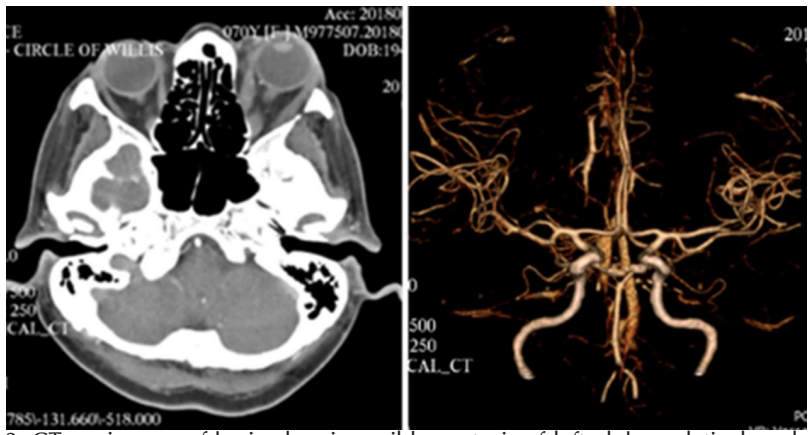

Figure 2: CT angiogram of brain showing mild proptosis of left globe, relatively enlarged left medial rectus with no tendon involvement and normal superior ophthalmic vein. Normal cavernous sinuses.

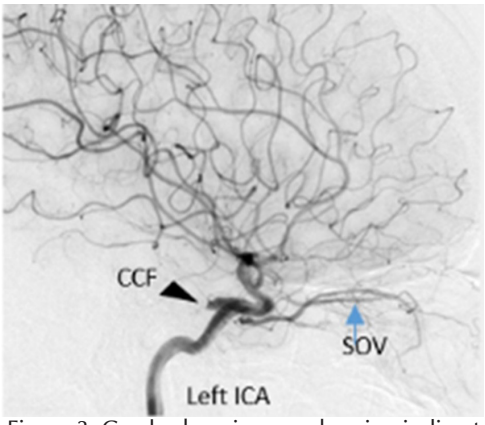

Figure 3: Cerebral angiogram showing indirect CCF with branches noted from cavernous segment of left ICA (black arrow)

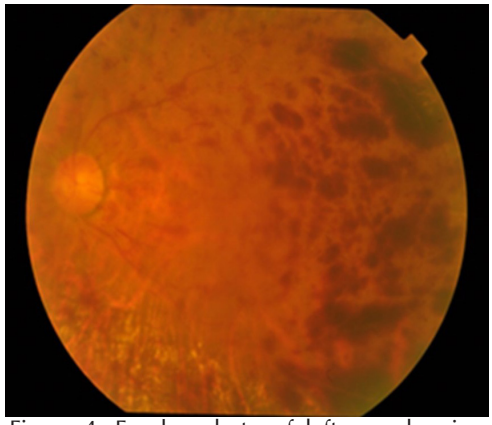
Figure 4: Fundus photo of left eye showing multiple dot-blot haemorrhages all 4 quadrants which indicate venous stasis retinopathy

examination showed massive dot-blot haemorrhages over all four quadrants of her left eye involving the macula (Figure 4) with cystoid macular oedema as shown on optical coherence tomography of left eye macula (Figure 5). Left optic disc was not swollen or hyperaemic. There was presence of neovascularisation of left eye iris at the pupillary margin. Gonioscopy showed that the angle was open in both eyes with presence of new vessels over the angle of left eye at the nasal, temporal and inferior quadrant. Left eye intraocular pressure remained high despite two antiglaucoma eyedrops. All the findings confirmed the diagnosis of venous stasis retinopathy and neovascular glaucoma as part of the complications of CCF. Left eye full panretinal laser photocoagulation was performed. She also received intravitreal ranibizumab injection for her cystoid macular oedema. Rubeosis iridis was noticed to have regressed after the intensive treatment. The patient finally had embolisation done over her left CCF by the interventional radiologist five months after her presentation. Unfortunately, despite all the intervention with improved cystoid macular oedema and controlled IOP, her vision had dropped to 2/60 one month later most likely due

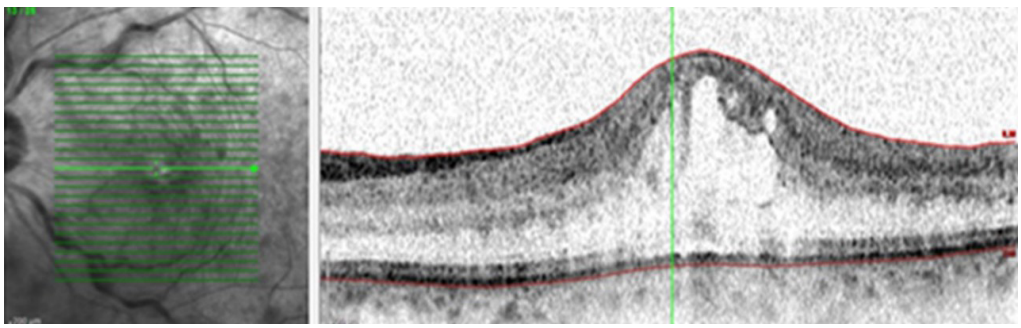
Figure 5: Optical coherence tomography of macula showing cystoid macular oedema

to macular ischaemia. There was no fundus fluorescein angiography or optical coherence tomography angiography done to confirm this postulation as patient was not keen for further intervention due to poor visual outcome.

DISCUSSION

CCF is a condition in which there is an abnormal communication between carotid artery and cavernous sinus leading to abnormal vascular shunt (Chaudhry et al. 2009). CCF can be classified according to its anatomy, haemodynamic and aetiology. Anatomically, CCF can be divided into direct and indirect CCF in which direct CCF is when there is direct communication between carotid artery and cavernous sinus, whereas for indirect CCF, the abnormal communication is from the branches of carotid arteries (Ellis et al. 2012). Haemodynamically, it can either be a high flow or low flow CCF (Ellis et al. 2012).

CCF can also be classified by its aetiology which are spontaneous and trauma. Traumatic CCF happens when there is an abrupt raise of intraluminal pressure in ICA and compression of the distal artery which result in vessel wall rupture (Keltner et al. 1987). Spontaneous CCF typically occurs in post-menopausal women. It can be associated with cavernous carotid aneurysm and some genetic conditions such as Ehlers-Danlos syndrome, fibromuscular dysplasia and pseudoxanthoma elasticum (Ellis et al. 2012). In our case report, the patient had a spontaneous indirect slow flow CCF. The clinical presentations of indirect CCF might not be as typical as the direct ones and can be often misdiagnosed as other differential diagnosis of chronic red eye which will be further discussed later.

Direct CCF is usually high flow and typically progress rapidly which require urgent intervention. Patients commonly present with acute onset of proptosis, chemosis, orbital bruit and headache (Ellis et al. 2012). Some patients may have diplopia, blurring of vision and orbital pain. Compared to high flow direct CCF, the indirect ones are usually more insidious in onset with conjunctival injection being the most common symptom (Siu & Henderson 1974). Thus, it can be misdiagnosed as chronic conjunctivitis causing a delay in diagnosis (Chaudhry et al. 2009; Ellis et al. 2012). Especially in an atypical red eye, it is crucial to recognise conjunctiva arterialisation and auscultate for an orbital bruit which are present in 93% and 49%, respectively in a confirmed CCF (Chaudhry et al. 2009; Ellis et al. 2012). In this case, our patient did not have typical signs and symptoms of CCF most likely due to her CCF is indirect and slow flow in nature. She only experienced eye redness and gradual onset of proptosis without conjunctival chemosis, or orbital bruit.

Diplopia only present in 23-63% of cases of CCF and is usually caused by palsies of cranial nerve III, IV or VI which are located in the cavernous sinus. This condition is usually secondary to congestion of cavernous sinus due to blood flow from carotid

artery via the fistula (Stiebel-kalish et al. 2002). Interestingly, our patient did not have any problem with extraocular movement or double vision despite the enlargement of medial rectus and inferior rectus muscles. This could be explained by possibility of congestion of the extraocular muscle due to the fistula but cranial nerves were still intact in the cavernous sinus. As a result, she did not experience ophthalmoplegia. Anterior draining CCF which typically involves superior ophthalmic vein causes congestive manifestations and it is called as "red eye shunt", whereas in posterior draining CCF which involves sphenopalatine sinus and inferior petrosal sinus, oculomotor nerve palsy may happen without features of congestion. It is also known as "white eye shunt" (Li et al. 2019). This patient had a "red eye shunt" with preserved extraocular movement.

Several complications of CCF can lead to reduction of visual acuity. One of the causes is glaucomatous optic neuropathy secondary to raised intraocular pressure and congestion of orbital venous system (Stiebel-kalish et al. 2002). Besides that, orbital venous congestion can also lead to central retinal vein occlusion (CRVO) and ischaemic optic neuropathy. Patients also tend to develop exposure keratopathy when the proptosis is significant (Chaudhry et al. 2009). Fortunately, this patient did not develop exposure keratopathy because the proptosis was mild to moderate in severity and her bell's phenomenon was good. However, due to delay in diagnosis and treatment in our patient, she developed venous stasis retinopathy by evidence of multiple dot blot haemorrhages and slightly tortous vessels with macular oedema. She did not have the typical CRVO picture such as multiple flame-shaped haemorrhages at all the four quadrants with tortuous, dilated retinal vessels and cotton wool spots which her clinical presentation can be overlooked as diabetic retinopathy. There was no hard exudate over the macula and the fellow eye did not have any signs of diabetic retinopathy which increase the clinical suspicion of venous stasis retinopathy secondary to CCF. Visual impairment in a low flow CCF is usually due to chronic retinal hypoxia secondary to ineffective ophthalmic artery perfusion pressure, venous thrombosis and raised venous pressure which clinically present as venous stasis retinopathy (Alam et al. 2019). Venous stasis can range from just venous dilatation to retina vein occlusion. Some authors came out with "3 point sign" which is a predictive factor of visual loss. It includes optic disc hyperaemia, retinal venous dilatation and intraretinal haemorrhage, in which presence of all 3 signs will most likely cause visual loss (Alam et al. 2019). However, not all patients with CCF will have all of the three signs. Our patient, for example, had only 2 signs but she still developed progressive visual loss. Besides that, the ischaemic nature of the disease had made the clinical scenario more complicated by causing neovascular glaucoma evidenced by the presence of new vessels over the iris and angle.

The gold standard imaging tool is cerebral angiography as it can

directly visualise the feeding vessels to cavernous sinus. It can be performed via transfemoral arterial catheterisation or from internal and external carotid artery approach (Ellis et al. 2012). However, due to its invasiveness and possibility of bleeding and stroke, CTA can be performed instead. CTA is a non-invasive imaging to look for dilated superior orbital veins (SOV), thickened extraocular muscles (EOM), proptosis, enlarged cavernous sinus with convex lateral walls (Coskun et al. 2000; Chaudhry et al. 2009). Unfortunately, negative findings in CTA do not rule out CCF (Ellis et al. 2012). Although cerebral angiogram is not the first line investigation due to its invasiveness, it is indicated if clinical suspicion of CCF is high despite a normal CTA.

Orbital ultrasound can be used in the lack of resources. The key findings of ultrasound are orbital tissue congestion, mild thickening of EOM and dilatation of SOV. However, the thickening of EOM is more symmetrical compared to the asymmetrical enlargement of muscles in thyroid eye disease (Keltner et al. 1987). Colour Doppler on the other hand can demonstrate the arterialised blood in SOV (Keltner et al. 1987; Chaudhry et al. 2009; Li et al. 2019). Ultrasonography was not performed in this case due to the availability of CTA and cerebral angiogram which has gained the popularity nowadays due to their higher resolution.

Most of the CCFs are not lethal but the affected eye might be compromised as in this patient. Urgent treatment should be considered when there is presence of severe exposure keratopathy due to proptosis, diplopia secondary to cranial nerve palsy, intolerable headache or audible bruit, glaucoma and optic neuropathy (Chaudhry et al. 2009). Transarterial or transvenous embolisation of the fistula is the first line treatment for CCF with the success rate ranging 80-98% (Ellis et al. 2012). Transarterial approach can be done when the CCF originates from the branches of external carotid artery (ECA). If the feeding vessels are from branches of ICA, transvenous embolisation is preferred because it is relatively easier and reduces risk of stroke due to the embolic reflux (Kirsch et al. 2006). The goal is to completely occlude the fistula at the same time preserve the normal blood flow in ICA (Ellis et al. 2012). Intraoperative complications include ophthalmic artery occlusion, stroke and cavernous sinus thrombosis although they are not common (Chaudhry et al. 2009).

Surgical ligation of internal or external carotid arteries is no longer practised due to its complications. Besides that, detachable balloon, metallic coils, glue or liquid embolic agents can be used for fistula embolisation (Miller 2007). Spontaneous closure after angiography is previously reported but only applied to indirect slow flow fistula (Miller 2007). Manual carotid compression has shown to be successful in some of the cases.

Resolution of pre-existing symptoms depends on the severity and duration of the disease before the intervention. Generally, chemosis and proptosis resolve within hours to few days after successful complete closure of CCF. However, cranial nerve palsy might

take several weeks to resolve (Meyers et al. 2002). Visual prognosis depends on the pathogenesis, duration and severity of CCF. Prognosis is poorer in patients with direct CCF, longer duration from onset of symptoms to intervention and more severe presenting symptoms (Ellis et al. 2012). Besides that, patients who present initially with loss of vision have higher risk of having residual ophthalmic symptoms post intervention (Grumann et al. 2012).

CONCLUSION

A normal CTA should warrant a diagnostic cerebral angiography if CCF is highly suspected. Delaying in diagnosis and intervention may lead to blinding complications of CCF such as venous stasis retinopathy, ischaemic optic neuropathy and glaucoma.

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